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# NASA TECH BRIEF

*Lewis Research Center*



## Properties of Air and Combustion Products of Fuel with Air

Thermodynamic and transport properties have been calculated for air, the combustion products of natural gas and air, and the combustion products of ASTM-A-1 jet fuel and air. Properties calculated include: ratio of specific heats, molecular weight, viscosity, specific heat, thermal conductivity, Prandtl number, and enthalpy. These properties have been calculated for temperatures from 300 to 2800 K (80 to 4580°F) in 100 K (180°F) increments at pressures of 20, 30 and 40 atmospheres. The data for natural gas and ASTM-A-1 were calculated for fuel-air ratios from 0.01 to stoichiometric in 0.01 increments. The data are presented in the referenced report.

The calculated property data in the report are for the combustion products of defined fuels. However, it is estimated that the difference between calculated thermodynamic and transport properties of the combustion products of ASTM-A-1 burned in air and the properties of any of the typical JP fuels burned in air will be less than 0.5 percent for the same equivalence ratio. Likewise, errors of less than 0.5 percent will be introduced if the thermodynamic and transport properties of the combustion products of natural gas are used for the properties of the combustion products of methane or any natural gas composition.

The analytical investigation described was conducted to determine properties for the gas compositions, pressures, and temperatures encountered in current and projected jet engine cooling studies. Accurate values of the thermodynamic and transport properties are not available in the literature over the required range of pressure and temperature. These property data are required for designing jet cooling configurations for combustor liners and turbine vanes, blades, and end walls.

The data should be useful for generation applications in gas turbines and for a variety of industrial combustion processes.

### Notes:

1. Further information is available in the following report:
   NASA TN-D-7488 (N74-12575), Thermodynamic and Transport Properties of Air and Its Products of Combustion with ASTM-A-1 Fuel and Natural Gas at 20, 30 and 40 Atmospheres
   Copies may be obtained at cost from:
   Aerospace Research Applications Center
   Indiana University
   400 East Seventh Street
   Bloomington, Indiana 47401
   Telephone: 812-337-7833
   Reference: B75-10004
2. Previously calculated properties of the same kind for pressures of 3 to 10 atmospheres, announced in Tech Brief 69-10711, are available in the following report:
   NASA TN-D-5452 (N69-37936), Thermodynamic and Transport Properties of Air and the Combustion Products of Natural Gas and ASTM-A-1 with Air
   Copies may be obtained at cost from the Aerospace Research Applications Center at the address above.
3. Specific technical questions may be directed to:
   Technology Utilization Officer
   Lewis Research Center
   21000 Brookpark Road
   Cleveland, Ohio 44135
   Reference: B75-10004

### Patent Status:

NASA has decided not to apply for a patent.

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Category 03